

REMARKS

Claims 12-16 and 18-23 are before the Examiner for consideration. Claim 17 has been canceled.

Applicants thank the Examiner for the courteous telephone interview with their attorney on November 17, 2004. The Section 112 rejection was discussed as further described below.

1. Claims 12-23 were rejected under 35 U.S.C. 112, second paragraph, as indefinite. This rejection is traversed.

The Examiner contends that "predominantly" is unclear in the basis or comparison, and whether any reaction is required. Claim 12 is amended further to define the "predominantly" expression to state that the predominant reaction with the alkali metal is "when compared with main components of the honeycomb carrier." Support for this matter is found in Paragraph [0024] explaining that normally reactive cordierite no longer reacts with the alkali metal when the anchor substance is added because the anchor substance provides the largest suppression of the carrier deterioration. Applicants submit that this clarifying amendment raises no new issue because the predominant reaction of the anchor substance with the alkali metal has been fully searched and understood during the extensive prosecution of this application.

The catalyst body is made up of five components:

1. a honeycomb carrier,
2. an alkali metal,
3. a heat resistant inorganic oxide,
4. a noble metal on that inorganic oxide, and
5. an anchor substance.

The anchor substance is defined as one that "reacts predominantly with said alkali metal" and by the present amendment in claim 12 with the additional characterization "when compared with main components of the honeycomb carrier."

Applicants submit "predominantly" is definite. The artisan is informed that in this catalyst body of five components only the anchor substance will predominantly react with the alkali metal, as explained in the specification at page 3, lines 9-23, thusly:

[0007] The catalyst body of the present invention comprises a carrier and a catalyst layer containing an alkali metal and/or an alkaline earth metal, loaded on the carrier, which catalyst further contains a substance capable of reacting with the alkali metal and/or the alkaline earth metal, dominating over the reaction between the main components of the carrier and the alkali metal and/or the alkaline earth metal, and this substance is hereinafter referred to as "anchor substance". With this catalyst body, even when the catalyst body is exposed to a high temperature during the use, the alkali metal and/or the alkaline earth metal in the catalyst layer reacts predominantly with the anchor substance;

thereby its reaction with the carrier is suppressed; and resultantly, the deterioration of the carrier is suppressed. (emphasis added)

This paragraph first explains that the catalyst contains the "anchor substance" which is "capable of reacting with the alkali metal . . . dominating over the reaction between the main components of the carrier and the alkali metal."

The paragraph then explains that even at high temperatures "the alkali metal . . . in the catalyst layer reacts predominantly with the anchor substance."

The paragraph finally explains that the reaction of the alkali metal with the carrier is suppressed because the alkali metal will react predominantly with the anchor substance; the alkali metal will not react with the carrier. The end of the last sentence reads: "and resultantly, the deterioration of the carrier is suppressed."

The artisan therefore knows that the anchor substance will be reacting with the alkali metal and that none of the other components in the catalyst body will be reacting predominately with the alkali metal and that the alkali metal will not be reacting with the carrier.

The Examiner questions whether the anchor substance will

react with the alkali metal. If a car is never driven, no reaction would take place in a catalytic convertor. However, as a car driver knows when a car undergoes vehicle emission inspection, over time the performance of the catalytic converter drops due to deterioration of the catalytic converter. Thus the real world drivers are interested in extending the life of the their catalytic converters. They would look forward to the present catalyst containing an anchor substance that permits longer catalyst carrier life by preventing the catalytic alkali metal from reacting with the carrier.

A second paragraph that supports "predominantly" appears at page 3, line 24 to page 4, line 5, and reads:

[0008] Of the alkali metals and/or alkaline earth metals used as the catalyst component, Li, Na, K and Ca deteriorate the carrier seriously. Therefore, when such a catalyst component is used, it is preferred to use, as an anchor substance, a substance reactive predominantly with the catalyst component. The kind of the anchor substance used differs depending upon the material of the carrier used; however, specific examples of the anchor substance are B, Al, Si, P, S, Cl, Ti, V, Cr, Mn, Ga, Ge, As, Se, Br, Zr, Mo, Sn, Sb, I and W. (emphasis added)

This paragraph explains to the reader that the alkali metals cause the carrier to deteriorate. Thus, when an alkali metal catalyst component is used, it is preferred to use as an anchor

substance "a substance reactive predominantly with the catalyst component." The preferred anchor substances are listed also in this paragraph. The passage clearly and definitely explains to the artisan the nature of the anchor substance and how it is to react predominantly with the alkali metal.

During the above-mentioned telephone interview, the Examiner suggested that "preferentially" might be a better term than "predominantly." As noted already, applicants chose "predominantly" and the term adequately informs the artisan of the invention. The two terms seem adequately to describe the same degree of reaction and thus could be considered equivalent. However, if the Examiner believes after reviewing applicants' arguments above that "preferentially" is preferred, the Examiner is requested to call applicants' undersigned attorney to discuss the point.

Accordingly, review and withdrawal of this rejection are requested.

2. Claims 16-23 were rejected under 35 U.S.C. 102(a) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Iizuka et al. 5,968,870. This rejection is traversed.

The present invention is directed to solving a problem caused by the adverse effect alkali metals have on a catalyst carrier in catalyst compositions when the catalyst operates at high temperatures. This problem is discussed on page 2, lines 2-10, of the specification thusly:

The carrier, however, is easily corroded and deteriorated by alkali metals or some alkaline earth metals being activated under high temperature conditions derived from automobile exhaust gas, especially, Li, Na, K and Ca. In particular, there is a serious problem that a cordierite carrier made of an oxide type ceramic material generates cracks, since the carrier easily reacts with the above-mentioned alkali and alkaline earth metals, etc.

Applicants solved this serious prior art problem by inventing a catalyst having a long duration period. The catalyst of this invention is formed by adding an anchor substance that reacts predominantly with the alkali metal. As a result, any reaction dominating over the reaction between the main components of the carrier and the alkali metal is suppressed. See also specification Paragraphs [0005] and [0006]. Preferred anchor substances are recited in claims 13, 16 (incorporating now-canceled claim 17) and 21. There is no teaching in the cited art of adding such an anchor substance that predominantly reacts with alkali metal to a catalyst composition for any reason, let alone to solve this durability problem. It is noted that Iizuka et al. '870 is not applied against

claims 12-15 for the embodiment where the anchor substance is present in the catalyst layer.

The Office Action raises two issues discussed below as (A) and (B).

A. Iizuka et al. '870's impregnation in col. 4 makes the claimed catalyst

The Examiner contends Iizuka et al. '870's teaching in col. 4 of impregnating a cordierite honeycomb with alumina and then with Na, Ti and Pt produces the presently claimed catalyst. The Examiner contends there is no difference in that catalyst and the examples in applicants' specification.

Iizuka et al. '870 discusses preparation of a catalyst (see col. 4, lines 31-54,) using the following steps:

1. An alumina coated honeycomb having an alumina coating of nearly 160 g per apparent volume of honeycomb of 1 liter was obtained by coating a slurry, which was formed of alumina powder, aluminum nitrate, and aluminum hydroxide, and prepared in nitric acid, to a honeycomb (400 cells/in²) made of cordierite; and the alumina coated honeycomb was then dried and baked.

2. The alumina coated honeycomb was impregnated with Ce nitrate solution, then dried at 200°C., and baked at 700°C. for 1 hour.

3. The alumina coated honeycomb was impregnated with a mixed solution of Na nitrate and Mg nitrate and nitric acid titania sol, and dried and baked using the same conditions as above.

4. Further, the alumina coated honeycomb was impregnated with a mixed solution of dinitro-diamine Pt nitrate solution and Rh nitrate solution, then dried at 200°C. and baked at 450°C. for 1 hour.

5. Finally, the alumina coated honeycomb was impregnated with Mg nitrate solution, dried at 200°C., baked at 450°C. for 1 hour, and baked at 700°C. for 5 hours.

The reason for using Ti is explained in Iizuka et al. '870 at col. 2, lines 35-39:

The reason the catalyst in the present invention has a high purification capacity for NO_x is that a high affinity for NO_x is created by Ti coexisting with alkali metal NO_x is absorbed on a surface thereof, and the absorbed NO_x is reduced by a [SIC] coexisting with noble metal.

The Ti is only for coexisting with the alkali metal to increase the affinity of NO_x for the alkali metal. There is no

suggestion that the Ti would prevent deterioration of the carrier when the carrier reacts with an alkali metal.

The claims as they now read no longer list Ti in the anchor substances in claims 13, 16 (incorporating now-canceled claim 17) and 21; thus, there is no teaching of the anchor substances of these claims.

There is no teaching of the embodiments in claim 16 (anchor substance in the carrier) and claim 20 (anchor substance between the carrier and the catalyst layer) in Iizuka et al. '870.

B. Cordierite will have Si and Al not in the cordierite structure to serve as an anchor substance

Cordierite is a conventional carrier for auto exhaust catalysts, nominally a magnesium aluminum silicate of the formula $Mg_2Al_4Si_5O_{19}$. The Examiner apparently believes there will be unreacted Si and Al present in the cordierite that will serve as an anchor substance. However, Iizuka et al. '870 has no discussion or suggestion of such inherency. The only mention of the cordierite is in col. 4, lines 31-37, where a honeycomb (400 cells/in²) made of cordierite is coated with alumina. There is no discussion of the composition of the cordierite honeycomb nor any possibility that any Si or Al could be present.

Applicants believe commercial cordierite has no significant impurities. Furthermore, the amount of the alkali metal to be used for the NOx catalyst is far larger than the amount of the metal derived from the impurities that may be contained in water to be used for the processing during the production of the catalyst body. Thus, the assertion that the cordierite of Iizuka et al. '870 has a substantial amount of free Si or Al to serve as effective amount of an anchor substance is not supported by the disclosure in this reference. The Examiner is asked to provide more detail in support of his position.

Accordingly, review and withdrawal of this rejection are requested.

3. Claims 12-23 were rejected under 35 U.S.C. 103(a) as unpatentable over Lindner et al. '430 taken with Deeba et al. '910. This rejection is traversed.

There is no proper reason to look to the teachings of Deeba et al. '910 and conclude that alkali metal could or should be used in the Lindner et al. '430 three-way noble metal catalyst construction for the reasons of record.

The person of ordinary skill in the art would have no motivation to combine the teachings of Lindner et al. '430 and Deeba et al. '910 to solve the prior art problems discussed in the paragraph [0003] bridging pages 1 and 2 of the specification. Neither reference discusses the problems caused by the use of alkali metals as NO_x adsorbents, which problems are solved by the present invention. There are also major differences in catalytic mechanism, function, and operation between a ternary catalyst and an NO_x adsorption catalyst.

If no alkali metal is disclosed in the primary reference (as the Examiner admits), why would the person of ordinary skill in the art have any reason to look Deeba et al '910 in an effort to solve the corrosion and/or deterioration problems caused by the presence of alkali metals in NO_x adsorption catalysts? The secondary reference does not discuss alkali metals and an anchor material therefor, or as described in independent claims 12, 16 and 20, "an anchor substance . . . that reacts predominantly with said alkali metal," and "whereby any reaction between main components of the carrier and said alkali metal is suppressed." The basis for the combination of references rejection shows that the Examiner has been looking improperly to what is said in applicants'

specification (impermissible hindsight) rather than to what the reference themselves say.

The argument directed to the "optional" use of an alkali metal in Deeba et al. '910 is used in support of applicants' position that the subjects matter of the two references are sufficiently unrelated that a person of ordinary skill in the art, absent the hindsight provided by applicants' specification, would have no reason or desire to combine them. If an alkali metal is an optional component in Deeba et al. '910, then clearly the reference is not directed to dealing with problems that are caused by the presence of an alkali metal.

Applicants again respectfully submit that the systems of Lindner et al. '430 and Deeba et al. '910 are drastically different and merely because the systems are used in exhaust gas catalysts, that characteristic does not justify the instant rejection.

The Significance of These Two References Being Directed to Different Types Of Automotive Catalysts

a) Linder - Passive Catalyst System - Operating at Stoichio-metric Point

The Linder catalyst is a three-way catalyst system used for normal engines where exhaust gas is controlled to the stoichiometric point. This catalyst system is a "passive" catalyst

system, that is, it converts CO, HC, and NOx to harmless components at the same time and constantly in a stoichiometric atmosphere.

This catalyst is composed generally of:

- 1) a noble metal,
- 2) a support (heat resistant inorganic oxide such as γ -Al₂O₃),
and
- 3) an oxygen storage material (such as CeO₂ to keep the exhaust gas composition stoichiometric).

b) Deebea - Active Catalyst System - Operating in a Lean Atmosphere

The Deebea catalyst is for an NOx adsorption catalyst system that is used for a lean burn engine or a direct injection engine where the exhaust gas is in a lean atmosphere, that is, there is excess O₂ in the atmosphere. This catalyst system is an "active" catalyst system, that is, it adsorbs NOx during lean operation. Then introducing a rich spike at intervals discharges the adsorbed NOx, and the discharged NOx is converted to harmless components, so that saturation of NOx in the adsorption material is avoided.

This catalyst is generally composed of:

- 1) a noble metal,
- 2) a support (heat resistant inorganic oxide such as γ -Al₂O₃),
and

3) an NO_x adsorption material (such as Ba, K to hold NO_x in the form of nitrate).

As noted, the treating gas and the reaction mechanisms of Linder and Deeba catalyst systems are totally different. Thus, an artisan would not think that an effective component for one catalyst system is effective for another catalyst system acting by a different reaction mechanism. This perception is a common sense one in chemistry. Therefore, with no suggestion or teaching to do so, the skilled person could not combine the Linder and Deeba teachings.

In other words, because these two references relate to different types of automotive catalysts, no suggestion is provided by or in the references to combine their features. As already noted, the recited objects for the Lindner catalyst establish that it is merely an ordinary automotive catalyst with noble metals to provide for high temperature resistance. Deeba, on the other hand, is directed to a NO_x conversion catalyst primarily having an alkaline earth (Ba) component. There is no suggestion to the person of ordinary skill in the catalyst art to take a Deeba NO_x catalyst component and randomly add it to a conventional noble metal-containing auto exhaust catalyst. No reason exists, other

than by the improper resort to hindsight, to do so. There clearly is no teaching in these two references of the unexpected and superior results obtained by applicants and compiled in Tables 1 and 2 of the specification.

The Examiner notes with respect to claim 16 (where the anchor substance is in the carrier) that in the alumina embodiment of Lindner, oxygen is/can be the 'main component', Al is/can be the 'anchor substance'. However, alumina has the formula Al_2O_3 where both Al and O are chemically reacted together. No disclosure here that free Al is available to react with an alkali metal. Note especially that Linder et al. has no alkali metal.

The Examiner further notes regarding claim 20 (where the anchor substance is between the carrier and the catalyst layer) that column 7 teaches zirconium between the noble metal and the support. Apparently the Examiner is referring to col. 7, lines 11-25, which states that the first layer on the support contains zirconium oxide. This material serves as a support for the noble metal and it is not disclosed as an alkali metal reactant. Note again that Linder et al. has no alkali metal.

Accordingly, review and withdrawal of this rejection are requested.

Examiner Response to Argument

Page 3 of the Office Action contains five sentences identified below as RA1-RA5.

The first two (RA1 and RA2) appear to be taken together.

RA1 - Claims are not as narrow as argued

RA2 - One ingredient may perform several functions

Reply: In the Amendment Under 37 CFR 1.111 filed June 21, 2004, claims 1-11 were cancelled and replaced by claims 12-23. Claim 12 defines the carrier in part (1) and defines a catalyst layer in part (2) having a heat-resistant inorganic oxide in sub part (b). These two different components are narrowly defined and they perform separate functions.

The RA3 sentence can be broken into two parts (a) and (b).

RA3a The anchor substance need not be a separate component

Reply: Claim 12 states the anchor substance is in the catalyst layer and thus it is a component separate from the honeycomb carrier. In claims 16 and 20, the anchor component is a distinct, different component from the honeycomb carrier.

RA3b The anchor substance need not be a compound

Reply: This is correct. See page 4, lines 24-25 of the specification where the anchor substance is said to be a simple substance.

RA4 - Page 4 of the specification is not relevant and it supports the Examiner's position

Reply: This comment is not understood by applicants. In Section 2 on page 9 of the Amendment Under 37 CFR 1.111 filed June 21, 2004, applicants referred to page 4 of the specification. This mention of page 4 was to show that applicants intended as part of their invention to use Si as an anchor substance, especially when reactive K was used as the alkali metal. Thus, citation to page 4 is relevant to show that applicants intend to use Si as an anchor substance.

RA5 - The claims do not appear to require any chemical reaction

Reply: The claims describe the anchor substance as one that reacts predominantly with the alkali metal. Claim 12 is amended further to indicate that the predominant reaction with the alkali metal is so "when compared with main components of the honeycomb carrier." This statement is a positive one that reaction takes

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place during catalyst use. If the Examiner has any further suggestions on this point, applicants are willing to consider them.

Applicants note that their previous extensive remarks addressing the improper combination of Linder et al. '430 with Deeba et al. '910 were not addressed in the Response to Arguments section.

Applicants respectfully submit that the present application is now in condition for allowance. Accordingly, the Examiner is requested to issue a Notice of Allowance for all pending claims.

Should the Examiner deem that any further action by the applicants would be desirable for placing this application in even better condition for issue, the Examiner is requested to telephone applicants' undersigned representative at the number listed below.

Respectfully submitted,

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Date

CAW/EC/klb

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